University of Houston Cullen College of Engineering

[ParamETErs]

Spring 2010

RECALIBRATING OUR VISION

PHOTO BY THOMAS SHEA

The University of Houston is implementing measures to become the next Tier One research institution in Texas. Though the great state of Texas has three of the nation's biggest cities, the world's largest medical center, NASA and countless Fortune 500 companies—it has only three top tier institutions. Last November, people across the state voted to establish a National Research Fund supporting the rise of additional Tier One universities in Texas. By most relevant metrics, UH is at the forefront of this very important initiative.

At the UH Cullen College of Engineering, we've launched a strategic plan focused on this Tier One initiative. Our goal of becoming a top 50 program nationwide will be accomplished through a robust research program, industrial partnerships and commercialization, expanded educational offerings, outreach efforts and alumni support. I'm very happy to report, we've made tremendous progress toward our goals—our research expenditures have doubled in just two years, and our enrollment is up nearly 30 percent. We have established a new department of biomedical engineering and an undergraduate program in petroleum engineering. We are preparing to launch an honors program for engineering students in the fall and our alumni giving continues to increase.

In this issue of *Parameters*, we feature three stories highlighting more exciting progress we've made within the last couple of months. First, we feature two new faculty scholars hired to lead the departments of biomedical engineering and civil and environmental engineering. Second, we highlight the research efforts underway at the NSF-funded National Center for Airborne Laser Mapping. Last, we showcase the research partnership between the UH Texas Center for Superconductivity Applied Research Hub and SuperPower Inc.

Also in this issue, we spotlight the successes of our graduate and undergraduate students who are stellar both in and out of the classroom. We are proud of their many accomplishments as well as the progress the college has made to create a high quality learning environment for them and the many generations of Cougars to come.

Warm regards,

Joseph W. Tedesco

Joseph W. Tedesco, Ph.D., P.E.
Elizabeth D. Rockwell Endowed Chair and Dean

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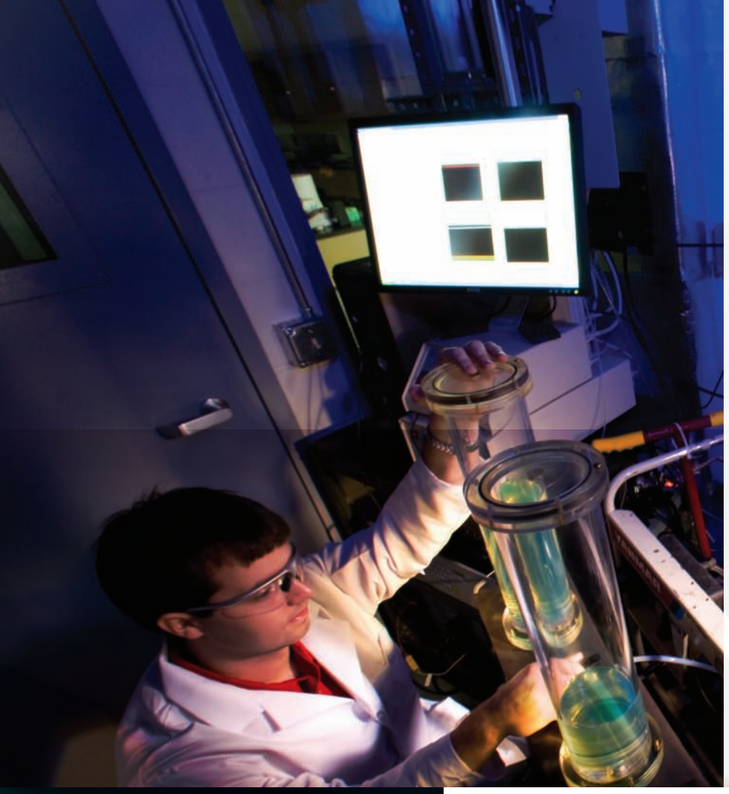
The University of Houston campus captured through laser mapping by researchers in the college's National Center for Airborne Laser Mapping (NCALM)

ON THE COVER

Recalibrating Our Vision
With a goal of becoming the next Tier One research institution in the state of Texas, the University of Houston is working hard to define and meet the metrics required of the country's top universities. At the UH Cullen College of Engineering, we are recalibrating our vision to become a nationally competitive engineering program to help UH achieve this Tier One goal.

FEATURES

RECALIBRATING OUR VISION



DIESEL CENTER Finishes Expansion

The Texas Diesel Testing and Research Center at the University of Houston recently finished an expansion doubling its size and increasing its means to research and test retrofit devices that reduce the amount of harmful pollutants emitted from heavy-duty diesel engine exhaust.

Funded with a grant from the Texas Commission on Environmental Quality, the expansion cost more than $9 million and took roughly a year to complete. Doubling lab space used for research and technology development, data analysis and emission testing, the diesel center now occupies 12,000 square feet in the University of Houston Energy Research Park.

Beyond the extra space, the expansion added advanced emission-testing equipment, including a 600 horsepower heavy-duty diesel engine dynamometer. It is the same piece of equipment the U.S. Environmental Protection Agency uses to verify retrofit technologies prior to their commercialization.

University Opens **Clean Room**

A new research facility has opened at the University of Houston to enable scientists to manipulate materials at the nanoscale in an environment virtually free from dust and other contaminants that can interfere with their results.

The UH Nanofabrication Facility features millions of dollars in state-of-the-art equipment in a more than 3,800 square foot space. Two of the three main rooms hold solvent and acid exhausted wet benches as well as materials synthesis and dry etching equipment in a class 100 air environment. The third, a lithography room, possesses a class 10 rating.

Developed in cooperation with the Alliance for Nanohealth, the facility is being used by UH researchers and is also available to others outside the university for a fee.

PHOTOS BY THOMAS SHEA

College Names **New Petroleum Program director**

Thomas Kennedy Holley, former senior staff geophysicist at Shell, took over as director of the University of Houston Cullen College of Engineering's petroleum program in April.

A highly respected researcher, Holley plans to use his more than 25 years experience to grow UH's petroleum program into the college's seventh department. This includes adding a Ph.D. to its existing master's degree and newly launched bachelor's degree options. The hope is that these degrees, along with UH's close proximity to leading companies in the industry, will work to fill gaps in the workforce with graduates that have the skills necessary to respond to the changing needs of the industry.

Researchers Partner in **National, International Centers**

Researchers at the University of Houston are partnering with some of the leading scientists in their fields in two separate centers funded by the U.S. Department of Energy and the National Science Foundation.

The first joins Demetre Economou and Vincent Donnelly, both professors of chemical and biomolecular engineering, with scientists from universities and national laboratories across the country. Led by researchers at the University of Michigan-Ann Arbor, the DOE gave roughly $10 million to those associated with the Center on Plasma Science.

"The goal of this center is really to understand the physics or the basic science behind what controls the energy distributions of ions and electrons in plasmas," said Donnelly, who will share $1 million of the $10 million total with Economou over the grant's five-year duration. "A better understanding of these relationships could make the plasmas used in lighting more efficient, advance the manufacturing of integrated circuits and even lead to developments in the field of medicine."

Pradeep Sharma, UH's Bill D. Cook Associate Professor of Mechanical Engineering, is part of the second center—the International Institute for Multifunctional Materials for Energy Conversion.

He is one of five principal investigators on the project, led by a researcher from Texas A&M University, that is centered on exploring ways to meet the nation's future energy needs. NSF has awarded these researchers $4 million to fund work that looks at how different materials can be used in energy transmission, storage and conversion during the next five years.

Beyond this, Sharma and other center researchers will be teaching short courses at partnering institutions in North Africa, the Middle East and the Mediterranean.

Gift to Support **Wind Lab, Students**

As part of an annual contribution to the University of Houston, BP America representatives presented a $85,500 check to the Cullen College of Engineering in support of educational initiatives.

The majority of the gift will support the college's Wind Energy Undergraduate Laboratory Experiment—allowing the construction of a wind tunnel for students to learn the fundamentals of converting wind energy to electrical power.

Through the project, students will test the different variables contributing to the challenges surrounding wind energy conversion. A variety of experiments will be carried out to test wind velocity, air density and the impact of the wind turbine blade's geometry and configuration.

RECALIBRATING OUR VISION

Features by Erin D. McKenzie || Photos by Thomas Shea || Photo Illustrations by Harriet Yim

Tier One universities are leaders. They carry a national brand and prestige that brings with it world-class research and academic excellence.

The University of Houston is on track to be one of these high-performing Tier One institutions.

The UH Cullen College of Engineering is supporting this mission with a strategic plan that serves, in part, as the framework for Tier One. Through it, we are recalibrating our vision to reach new goals that demand excellence in teaching, intellectual exploration and outreach.

Significant progress has been made, already. We are bringing some of the most talented engineers in the field to the college, and leveraging our research strengths to partner with industry to gain a more profound understanding of everything from restoring and improving aging infrastructure to developing economically viable renewable energy and advancing health informatics. Beyond this, we are reshaping our curriculum so our students graduate with the skills and experience necessary to deal with the challenges facing our modern day technical workforce.

It's progress, said Joseph W. Tedesco, Elizabeth D. Rockwell Chair and dean, which will help transform the university into a Tier One institution of choice and one day redefine the college as a top 50 program.

"In the short time since we launched our new strategic plan, we have recruited key faculty to lead our academic and research programs, created a strong presence at the UH Energy Research Park, and built industrial partnerships that will lead to research collaborations and technology transfer," said Tedesco. "We are definitely on the right path to becoming a top ranked engineering program."

Hiring the Best

METIN AKAY, Ph.D.

One key focus of our strategic plan is recruiting the best engineering scholars to join our prolific faculty.

Of our recent hires, two in particular were brought to UH this year to lead two of the college's six departments while strengthening our expertise in the areas of biomedical engineering and sustainability.

In the university's new Science and Engineering Research and Classroom Complex, Metin Akay is leading the first department added to the college in more than 35 years. As John S. Dunn Distinguished Professor and founding chair of the department of biomedical engineering, his vision for the department has him not only hiring close to a dozen faculty, but also expanding the program's focus and offerings.

First on Akay's list is to build new academic and research fields in biomedical imaging, neural and cognitive rehabilitation engineering, informatics as well as genomic and proteomics science and engineering.

"We need to establish a health care focused academic curriculum and entrepreneurship environment," said Akay, an internationally known researcher who recently was elected to the College of Fellows of the American Institute for Medical and Biological Engineering and the American Association for the Advancement of Science. "Restructuring the curriculum will help our department meet the demands and requirements of the ever-changing global economy that influences health care technology, management and delivery."

The main areas of emphasis, he noted, will be on cancer biomarkers, biomedical imaging, neural implants, intelligent drug design and delivery, neural engineering and modeling. They are areas where he has had significant scientific accomplishments. Among them—a noninvasive, wearable system for detecting coronary artery disease and a portable system for gauging the severity of Parkinson's disease, which allows doctors to monitor the disease's progress and tailor therapy accordingly.

Akay hopes to use this experience to stimulate further collaborations with the health care industry at the Texas Medical Center, located just a few miles from campus. Some he has already begun working with through the Institute of Biomedical Imaging Science—the research partnership formed by UH, The Methodist Hospital and Weill Cornell Medical College.

ABDELDJELIL "DJ" BELARBI, Ph.D.

Abdeldjelil "DJ" Belarbi, an alumnus of the college and a transplant from Missouri University of Science and Technology, is another new departmental leader. He recently took over as Hugh Roy and Lillie Cranz Cullen Distinguished Professor and chair of the department of civil and environmental engineering.

Belarbi's expertise in the sustainability of civil engineering infrastructure and advanced materials could not only propel the college's growth goal forward, but assist in solving one of the biggest problems facing the nation—aging infrastructure. For years, Belarbi has been studying ways to extend the life of the many great public works projects of the 20th century that are at or beyond their designated life span. He's also researching ways to better design transportation infrastructure in the future.

Through his eyes, this means using materials other than traditional concrete and steel. Fiber reinforced polymer (FRP) composite—a more durable, lighter material manufactured from different glass and carbon fibers and resins—could be the key.

"Repairing, strengthening and replacing deteriorated and damaged civil infrastructures has become one of the most critical issues for civil engineers across the world," said Belarbi. "A large portion of our infrastructure really wasn't designed to be around this long. These advanced materials could prolong the life of these structures, and overcome things steel and concrete simply cannot resist by themselves like fatigue, corrosion and other harsh environments."

Belarbi is also exploring an off shoot use of this material that could allow for the quick repair—within a matter of a few days—of bridges damaged by earthquakes and hurricanes. This, he said, would keep them operational during a crisis. Additionally, his work could help immediately assess the health of structures that have gone through these natural disasters by way of sensors that are embedded in structures so they can be continuously and remotely monitored.

Under his leadership, both the graduate and undergraduate curriculum will be updated to better respond to these infrastructure preservation challenges, and faculty with talent in the areas of hydro-systems, infrastructure, geo-sensing, nanomaterials and environmental engineering will be added to help establish programs and teach this new core curriculum.

"The world is changing rapidly and civil and environmental engineers must deal with some of the most critical issues facing society," said Belarbi. "The city of Houston is faced with many of these issues and the CEE department at UH should be positioned to serve the Greater Houston community, the state of Texas and the nation by educating engineers who not only possess the requisite technical skills, but would serve as tomorrow's leaders."

Expanding the Research Enterprise

RAMESH SHRESTHA, Ph.D.

Since the launch of the strategic plan, the Cullen College has successfully maintained consistent increases in its research support. The funding is supporting research that is allowing us to do everything from develop technologies that remove harmful toxins from diesel engine exhaust to better grasp how materials behave at the nanoscale.

This research—driving forward major growth areas for the college in nanomaterials, energy and sustainability research—set a new record in fiscal year 2009 when research grant and contract expenditures doubled. This rise from $11.5 million to more than $21.8 million also contributed to a university-wide spike that brought UH one step closer to its goal of becoming a Tier One public research institution.

With the start of this spring semester, the college achieved its aim of establishing a center funded by the National Science Foundation. Its director, Ramesh Shrestha, who now serves as Hugh Roy and Lillie Cranz Cullen Distinguished Professor of Civil and Environmental Engineering for the college, brought the National Center for Airborne Laser Mapping (NCALM) to UH from the University of Florida.

Focused on airborne laser swath mapping and ground-based scanning laser technology research, the center has helped arm earth scientists across the country with detailed information on everything from beach erosion and landslides to drainage patterns and faults.

A plane, specially equipped with state-of-the-art laser surveying instrumentation and GPS systems, has taken center scientists to map sites that include the Cedar River in Iowa that poured over its banks and nearby levees at 500-year flood levels causing the evacuation of thousands in 2008 and to ground zero days after the terrorist attacks on the World Trade Center in 2001. The center's work in Florida alone was instrumental in the state's decision to mandate the replacement of traditional surveying methods with laser mapping for yearly monitoring of coastline erosion.

Now operated jointly by researchers at UH and the University of California-Berkley, the center is setting its sights even higher since its move to Houston.

Aided by the National Science Foundation, NCALM researchers are exploring the possibility of using Light Detection and Ranging (LiDAR) to map everything from glacial movements to the migration of penguin colonies in Antarctica.

Using the technology, researchers take measurements of the ground's surface from their Cessna 337 Skymaster airplane.

From roughly 2,000 feet, this remote technology measures properties of scattered light through the use of laser pulses. Thousands of small cone-shaped pulses travel through a hole in the bottom of the plane to the ground below. A unique detector picks up rays reflected from the ground. Then, each point's distance is determined by measuring the time delay between the transmission of a pulse and the detection of reflected signals.

The plane's location and movement in the air are tracked by an inertial measurement unit (IMU) fixed inside the laser system along with a GPS receiver mounted to the plane, and others on the ground. Both are used, along with the laser data, to produce detailed 3D topographical images of the terrain.

In coming years, the UH group plans to develop a next generation LiDAR system. The unit, less expensive than commercially available systems, would allow for some of the most accurate, highest resolution observations possible in laser mapping.

"We want to develop a system like no one else has developed," said Shrestha. "It would really change what could be done with this technology. It would have new features, be faster, smaller and capture more each flight than we can today."

This system would use a much shorter pulse length laser, Shrestha said. This would increase the number of points they could map per second to 800,000—adding to data accuracy and reducing the amount of time in air needed to collect the information. On top of this, it would be able, for the first time, to penetrate shallow water depths.

The research team is submitting a proposal to fund the upgrade, which would not only increase the possibility of its commercialization, but could bring more jobs to the area. They are also working to develop graduate curriculum at UH catering to this specialty.

"In the last seven years or so that the center has existed, we have helped, in part, to produce technology that the private companies have used," said Shrestha. "This was something just starting in the late 1990s. With the center we have brought its uses to the forefront. We expect to continue to have that impact at our new home in Houston."

Partnering to Advance Technology

VENKAT "SELVA" SELVAMANICKAM, Ph.D. with SuperPower Researchers

As the nation's fourth largest city, Houston is home to the world-renowned Texas Medical Center as well as one of the country's busiest industry hubs. UH researchers are taking advantage of this central location amidst some of the leading energy, manufacturing, health care and aeronautics companies.

Collaborations between UH faculty and industry researchers are furthering scientific discovery in areas of national need and impacting economic development in the region that will help the area better cope with what the U.S. Bureau of Labor Statistics calls a growing shortage of skilled, technical workers.

One of the most promising new ventures that is making headway is The Texas Center for Superconductivity Applied Research Hub. The hub stands to bring industrial leaders in the field of superconductivity to Texas with the goal of accelerating development of this emerging technology.

"High temperature superconductivity has the potential to revolutionize the way we use electricity," said Venkat "Selva" Selvamanickam, M.D. Anderson Chair Professor of Mechanical Engineering and director of the applied research hub. "The new research hub leverages existing assets and creates key collaborations that move Texas forward as a leader for applications of superconductor materials in medicine as well as improves the efficiency, security and stability of the electric power grid."

The next step in more environmentally friendly energy, superconductivity uses certain ceramic and metal materials that are cooled with liquid nitrogen so they have no electrical resistance. Without this resistance, electrons can travel through these materials freely. This allows wires to be fabricated into power cables that can carry large amounts of electric current for long periods, without losing energy as heat, to deliver up to 10 times more power than traditional cables.

While additional energy can be carried more compactly, superconducting cables and wires remain considerably more expensive to produce than traditional copper cables. The research hub hopes to find ways to combat this, and other problems to make commercialization of superconductor products simpler and more cost efficient.

The hub is funded by a $3.6 million grant from the state's Emerging Technology Fund, established by Gov. Rick Perry and the Texas Legislature in 2005 to foster economic development in the state's technology sector. It stands to not only solve issues facing the industry through research, but also license those technologies to the partnering companies to be commercialized.

"We will work with companies on the issues facing the industry right now," Selva said. "And then we will solve those issues through our research here, license those technologies to the companies so they can go ahead and commercialize it and create jobs."

Selva is just the person to help in this. He has made a career out of superconductivity, starting with graduate work at the University of Houston that led to the creation of a new method for fabricating high-performance superconductors in 1988.

Most recently, he served as the vice president and chief technical officer for SuperPower Inc., a world leader in the development of high-temperature superconductors. There, he created and led a team to develop and scale up their products to commercialization.

Since joining the UH engineering faculty last year, Selva has continued to work closely with the company. They are the first partner in the new research hub and have plans to establish a facility in Houston. Together, SuperPower and hub researchers will work to further superconductor products based in the energy market, including transformers, wind generators, cables and fault current limiter.

Their first project together is to manufacture a fault current limiting transformer for electric utilities that will boost the reliability of the nation's power grid.

Funded with an additional $10.7 million from the U.S. Department of Energy, Selva, other UH researchers and SuperPower are collaborating with Waukesha Electric Systems, Oak Ridge National Laboratory and Southern California Edison to construct the fault current limiting superconducting transformer.

The UH researchers are expected to work closely with SuperPower on the creation and testing of the superconducting wire for the transformer within the Texas Center for Superconductivity and additional laboratory space in the new University of Houston Energy Research Park.

"Superconducting fault current limiters can enable uninterrupted power transmission when conventional circuits will otherwise succumb to outages in events such as lightning storms," Selva said. "We look forward to seeing our technology employed in a physical device when the transformer is installed four years from now in California's largest grid at the Southern California Edison utility substation."

Surendra P. Shah

Visiting Professor
Civil and Environmental Engineering

Education:
Ph.D. civil engineering, Cornell University

Biography:
Shah, the Walter P. Murphy Professor of Civil and Environmental Engineering at Northwestern University, joined UH this spring as a visiting professor. During his year-long appointment, he will be working with UH researchers to further the development of more durable, greener materials for the country's aging infrastructure. Shah is a member of the National Academy of Engineering and a fellow of both the Indian Academy of Engineering and Chinese Academy of Engineering. Throughout his career, he has been named one of the Top Ten Most Influential Persons in the Concrete Industry by *Concrete Construction* as well as an honorary professor at the Indian Institute of Technology and the University of L'Aquila in Italy. He has also received numerous awards from the American Concrete Society, American Ceramic Society, American Society of Civil Engineers, American Society for Testing and Materials and other international organizations.

Research Interests:
Most of Shah's research involves nanotechnology, fiber-reinforced concrete, high-performance concrete and the fracture mechanics of quasi-brittle materials. He works to connect nanoscale behavior to the structural response of concrete in an effort to develop more durable and sustainable infrastructure materials. Through his research, he has designed innovative nondestructive tools, such as electronic laser speckle infrometry and digital image correlation, to detect fractures in concrete.

Research Center:
Director of the NSF-funded Science and Technology Center for Advanced Cement-Based Materials at Northwestern University.

PHOTO BY THOMAS SHEA

BIOMEDICAL ENGINEERING

Metin Akay was inducted into the College of Fellows of the American Institute for Medical and Biological Engineering and the American Association for the Advancement of Science.

CHEMICAL AND BIOMOLECULAR ENGINEERING

Vincent Donnelly was featured in the fall 2009 issue of the University of Pittsburgh's Department of Chemistry newsletter as an outstanding alumnus of the program.

Michael Harold was elected to a three-year term on the Chemical Engineering Technology Operating Council of the American Institute of Chemical Engineers.

Ramanan Krishnamoorti served as a plenary speaker at the ARCHIPOL '09, the V Argentine-Chilean Polymer Symposium held last October in Los Cocos, Argentina. He was also appointed associate director of the Alliance for NanoHealth and to the executive board of the American Institute of Chemical Engineers' South Texas Section.

CIVIL AND ENVIRONMENTAL ENGINEERING

Ashraf Ayoub was appointed chair of the American Society of Civil Engineers' Emerging Computing Technology Committee.

Hanadi Rifai was elected to a two-year term on the Association of Ground Water Scientists and Engineers board.

Jerry Rogers is serving as co-editor of the Hoover Dam 75th Anniversary History Symposium Proceedings for the American Society of Civil Engineers National Annual Conference. In addition, his paper titled "The New Town of Boulder City: City Planning and Infrastructure Engineering for Hoover Dam Workers" has been accepted for publication in the American Society of Civil Engineers' National Engineering History publication.

ELECTRICAL AND COMPUTER ENGINEERING

Zhu Han received a National Science Foundation CAREER Award.

John C. "Jack" Wolfe is serving as interim chair of the department.

INDUSTRIAL ENGINEERING

Ali Kamrani was appointed as Princess Fatimah Alnijris's Research Chair for Advanced Manufacturing Technology (AMT) Visiting Professor for the department of industrial engineering at King Saud University in Riyadh, Saudi Arabia. At the university, he is conducting research that could have applications in the medical field.

MECHANICAL ENGINEERING

Fazle Hussain is serving as chair of the National Academy of Engineering's Mechanical Engineering Section. He has also been appointed Satish Dhawan Visiting Professor in the department of aerospace engineering at the Indian Institute of Science in Bangalore, India and distinguished adjunct professor in the department of nanomedicine and biomedical engineering at The University of Texas Health Sciences Center in Houston. In February, he served on the distinguished scientists panel at the American Society of Mechanical Engineers' 2010 Global Congress on NanoEngineering for Medicine and Biology in Houston.

John Lienhard's books, *How Invention Begins* and *The Engines of Our Ingenuity*, have been published in Chinese editions.

Venkat "Selva" Selvamanickam received a technical achievement award from Wire & Cable Technology International.

David Zimmerman is serving as interim chair of the department.

New Faculty

Jacinta C. Conrad

Title: Assistant professor of chemical and biomolecular engineering

Previously: Post-doctoral research associate, University of Illinois at Urbana-Champaign

Education: Ph.D. physics, Harvard University

Research: Conrad's research is focused on investigating the flow properties of complex fluid systems. Her research focuses on two main areas: exploiting microfluidic and microfabrication techniques to produce novel microstructured materials for transport studies and energy applications; and elucidating the interplay between confinement and flow properties of complex fluids and soft materials, with applications in biofluid transport, microbial motility, bioremediation and water purification.

Spotlight

The American Concrete Institute and the American Association of Civil Engineers jointly honored the structural engineering research contributions of Thomas T.C. Hsu, John and Rebecca Moores Professor of Civil Engineering, with a symposium in New Orleans, La. in November. The four-part symposium titled, "Thomas T.C. Hsu Symposium on Shear and Torsion in Concrete Structures" included 32 presentations from researchers around the world. An internationally-known researcher, Hsu's work with his Universal Element Tester has enabled engineers the ability to design more economical, safer concrete structures.

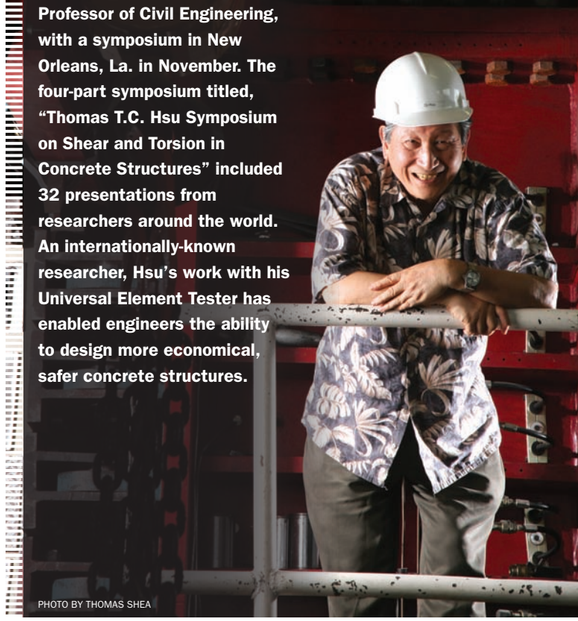
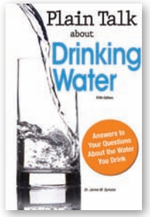
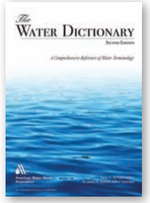


PHOTO BY THOMAS SHEA

In Print

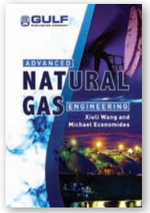
Drinking Water





In the fifth edition of his top-selling book *Plain Talk About Drinking Water*, James Symons, professor emeritus of civil and environmental engineering, answers some of the most commonly asked questions about tap water. Published by the American Water Works Association, the book explores contaminants, chlorine and fluoride, lead in water pipes, bottled water and many other relevant topics. He also published the second edition of *The Water Dictionary*, a book providing some 15,000 definitions on more than 40 water supply topics. Both books came out in 2009.

Natural Gas



As natural gas continues to meet world energy demand, harvesting and transporting the abundant resource more efficiently has become the focus of upstream, midstream and downstream production. Michael Economides, adjunct professor of chemical and biomolecular engineering, and Xiuli Wang (2000 PhD ChE), address many of the challenges and issues facing the industry in the book *Advanced Natural Gas Engineering*. Published in 2009, the book explores new technologies in natural gas exploration, requirements in gas well drilling, hydraulic fracturing, gas conversion, storage and transportation and competing energy sources.

NIH Challenge Grant to Fund Cancer Research

A team of University of Houston researchers has been awarded a competitive grant from the National Institutes of Health to create a technology that more efficiently identifies the presence of cancer in even the smallest of body fluid samples.

The team led by Dmitri Litvinov, professor of electrical and computer engineering, will use the $1 million to construct and test their biosensor's ability to spot cancer protein biomarkers for Chronic Lymphocytic Leukemia—a blood and bone marrow cancer. The device will use magnetic nanotechnology to locate these biomarkers, which are elevated in patients with the disease, on a single molecule level.

Under the Challenge Grant in Health and Science Research Program, Litvinov; Richard Willson, professor of chemical and biomolecular engineering; and other collaborators will test the technology's potential for sensing these often hard-to-detect biomarkers.

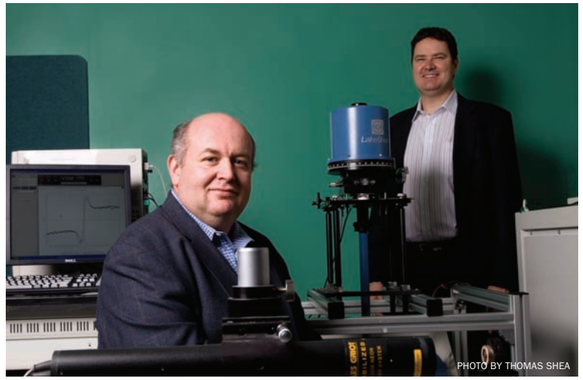


PHOTO BY THOMAS SHEA

Professor Working to Speed Data Transfers

To find ways of transporting electronic information over the Internet more efficiently, Yuhua Chen is developing a multimedia switching platform to make possible the transfer of all types of data with one piece of technology.

"There is currently no single technology suitable for all types of applications," said Chen, assistant professor of electrical and computer engineering. "This technology could create an extensible Internet infrastructure capable of transferring all types of data quickly."

Right now, information is transferred through one of three switching modes: electronic packet switching, optical circuit switching and optical burst switching. Each mode is optimized for specific types of data transfer, such as video, images or text.

With two National Science Foundation grants totaling more than $890,000, Chen will develop the platform, allowing electronic signals to be individually reconfigured to one of the three existing switching modes.

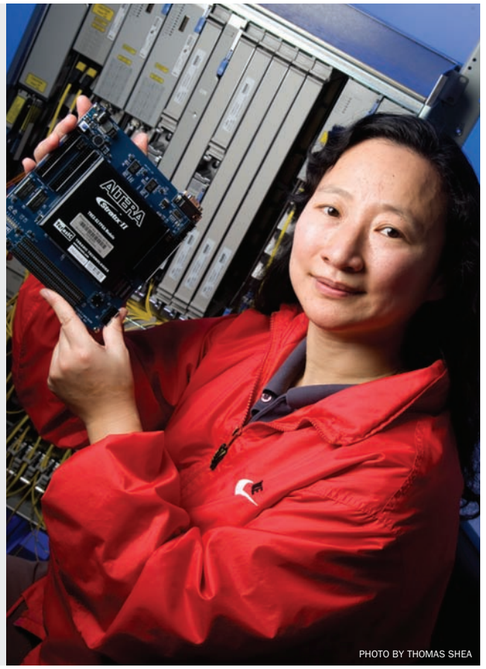


PHOTO BY THOMAS SHEA

UH RESEARCHER DOCUMENTS

Early Cardiovascular Development

PHOTO BY THOMAS SHEA

Imaging the cardiovascular system in its earliest stages of development could provide researchers unequivocal knowledge into how the heart forms and why. Until now, the developmental dynamics of the heart have been well theorized and modeled, though very little experimental visual evidence exists.

Kirill Larin, assistant professor of biomedical engineering, is working to change all of this by documenting the formation of the mammalian heart through a high-resolution, non-invasive imaging device, providing perhaps the best live imagery taken of the vital organ.

"Everything we know about early development of the heart and formation of the vasculature system comes from in vitro studies of fixed tissue samples or studies of amphibian and fish embryos," said Larin, who is using optical-coherence tomography to capture video of mice and rat embryos. "With this technology, we are able to image life as it happens, see the heart beat in a mammal for the very first time."

Larin and his collaborators at Baylor College of Medicine are using the technique to study cardiovascular abnormalities, which affect one percent of babies born today.

Over the course of several years, Larin has been refining his laser-based spectroscopic imaging system to provide high-resolution images of protein biomarkers in blood samples and to explore factors contributing to disease states. He has been working to adapt this technology to capture video of mammalian heart chambers as they more closely relate to humans.

Utilizing a $1.7 million grant from the National Institutes of Health, Larin plans to modify the device to improve its resolution and speed the imaging process so he can study developmental processes in animals with known heart abnormalities.

"At higher speeds and increased resolution, we'll be able to witness the dynamics—exactly what factors into the formation of the heart and what causes developmental problems," he said. "We'd like to discover how the different gene mutations affect cardiovascular development and ultimately reduce the number of babies born with abnormities."

Robotics Team Wins VEX Competition

Calculated maneuvers and solid design earned a team of University of Houston engineering students a first place win in the College Challenge at the Texas VEX Robotics Championship at Galena Park High School March 13.

For the event, college participants built and programmed two VEX robots that competed together in rounds of competition. The two pairs were placed on either side of a 12-foot-by-12-foot square, walled competition field. Separated down the center with a low barrier, each robot team was tasked with locating and throwing different sized balls—ranging in point value—onto its opponents' side during a 60-second autonomous period. In the second part of the match, the robots were tasked with the same mission, only this time for 80 seconds, while being remotely controlled by an operator.

College Names Outstanding Students

Students from two University of Houston Cullen College of Engineering departments were among those recognized for their high academic achievement in January.

Fernando Alquicira, a senior civil engineering major, and Gurwinder Singh, a junior chemical engineering major, were chosen from a pool of 13 students, selected from each of the seven programs, and named outstanding junior and senior for the 2009-10 academic year by the college.

New Technology Could Put an End to ICY COMMUTES

Christiana Chang lives where temperatures rarely dip low enough to produce snow let alone ice.

Yet in a lab at the University of Houston she is in the midst of perfecting something that just may garner a smile from those in regions where wintery weather wreaks havoc on commutes.

Self-heating roads.

They're the subject of her master's thesis and an idea she has been working on since earning her bachelor's degree in mechanical engineering from UH in 2008. In just two years already she has had big breakthroughs.

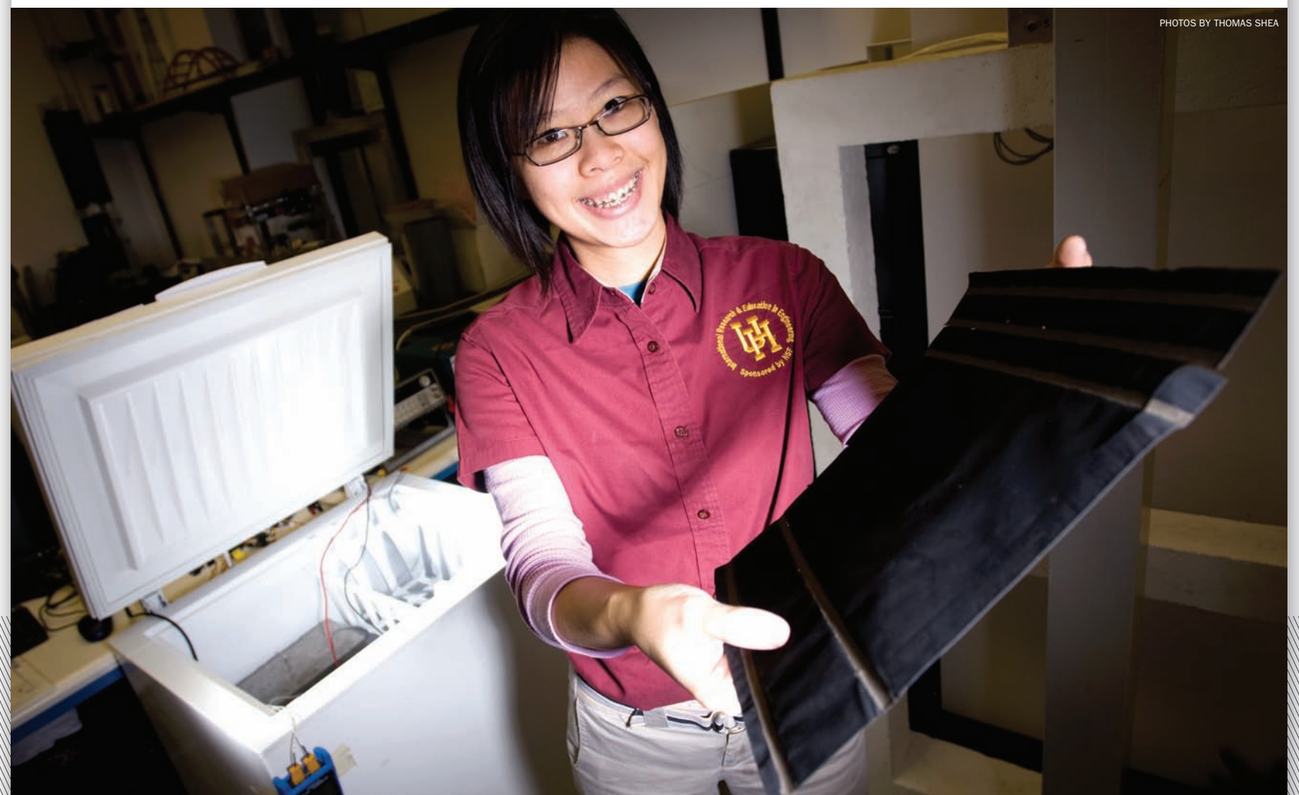
"We have been able to raise the surface temperature of concrete enough to get ice to melt," the Houston native boasted. Her results, showing a rise from 14 degrees Fahrenheit to near 32, were recently published in a technical note in the *Journal of Smart Materials and Structures*. It details her efforts to embed conductive carbon nanofiber paper in concrete to achieve deicing results.

"It is just like the coil on your stove," Chang explained of how the nanofiber paper works with the concrete. "All we have to do is apply electricity on either side of the paper. Since we are passing current through something that is resistive, it is going to convert that to heat energy."

Designed to mimic the depth of real roads, the paper rests three inches below the surface of a four by 10 inch slab of concrete. Another inch stands between it and the ground below. In tests where she applied just six watts of power to the paper in the model, the temperature on the surface of the concrete slab rose nearly 20 degrees in two-hours.

They are findings that have caught the attention of national media, including *New Scientist* magazine, as well as been picked up by numerous Internet bloggers interested in how her self-heating roads hold up to traditional methods such as salting and plows.

Prior to earning her advanced degree in mechanical engineering later this year, she will take testing from a small-scale model in a modified freezer in the lab to a road-sized footprint on a stretch of real roadway in Alaska.



PHOTOS BY THOMAS SHEA

UH EWB Chapter Travels to Nicaragua

Five undergraduate students from the University of Houston chapter of Engineers Without Borders (EWB) spent a week in Nicaragua, during spring break, on the organization's first official project outside the United States.

In the country, the group worked on the beginnings of what will be a five-year partnership with three tiny villages. About an hour drive from the capital—Managua—Telpochapa, La Uva and Bara Sonal residents will get help, through the UH partnership, to build their first elementary school as well as receive instruction on better agricultural and sanitation practices.

Using data collected on their most recent trip, the students will put together a complete plan for the school and education of the residents. Just as they did for the March trip, the group will present their ideas to the national organization. Upon approval by a panel of professional engineers, they will begin the next stage—implementation—likely in late August.

The UH chapter of EWB, which is dedicated to improving the quality of life in communities across the world through sustainable engineering projects, was founded three years ago.

SHPE Excels at National Conference

Not only was this year's national conference of the Society of Hispanic Professional Engineers (SHPE) the largest on record for the organization, it was the most well attended by students from the University of Houston chapter.

Forty-one students flew to the Washington, D.C. conference, which drew more than 3,700 for workshops, lectures, presentations, academic competitions and awards. The largest technical conference for Hispanics—Cullen College of Engineering students placed in three of its competitions.

In the round-the-clock Extreme Engineering Challenge, electrical engineering junior Danny Rodriguez, mechanical engineering senior Juan Caraveo and electrical engineering senior Judy Rodriguez teamed with seven other students from universities across the country. Intended to develop and promote students' engineering skills by simulating an accelerated scenario with deadlines, presentations, reviews and obstacles, their team took first place.

Earning second place in the technical poster competition was chemical engineering senior Kevin Rodriguez. He would place second again with Danny Rodriguez and mechanical engineering senior William Rifenburgh in the Academic Olympiad.

Mixing Technical Savvy *with* Creative Ability

Despite the constant demands of engineering studies, two University of Houston students are finding a balance that is allowing them to pursue their other, more artistic talents.

PROFILES BY ERIN D. MCKENZIE | PHOTOS BY THOMAS SHEA

Jessica Gray

Sophomore, chemical engineering

Jessica Gray knows the moves well. Each one—the brise, the pirouette, the arabesque, the developpe—she performs with beauty and grace.

This talent for the art of dance, in all its forms, is what helps her keep the pressures of engineering course work down. Gray spends hours dancing in the studio amid involvement in classes and membership in the student chapters of the National Society for Black Engineers and the Program for Mastery in Engineering Studies on campus.

The balance between engineering and dance, she admits, is not often easy but its something she has been managing since high school.

For her, summers were spent in a program dedicated to enriching young minds in science, math and engineering with the school year in Houston's High School for the Performing and Visual Arts (HSPVA). An audition the start of her eighth grade year earned her a place in the school where she split her day between academics and dance.

"It was really a unique experience that made my love for dance grow even more," she said, noting she had only two years dance experience before earning her place in the school. "I was exposed to so many things there—musicians and dancers that would fly in from across the country to share with us their talents."

Three summers in the competitive Kinkaid HISD Math, Science and Engineering Institute, grew her dedication to engineering. The invitation only program had her using AutoCAD, programming computers, even brushing up on career etiquette that helped her land a BP America internship the summer of her junior year.

It was this opportunity that forced Gray to choose which of her two loves—engineering or dance—to focus her concentration. For, that same summer, a successful audition landed the Houston native a spot in Alvin Ailey American Dance Theater—a prestigious, more than half-century-old modern dance company in New York, NY.

"It was a tough choice," the 20-year-old recalled. "It was either follow a career in dance with the dance company or take the summer internship with BP. In the end, I knew I was really good at academics and I didn't want to let that go to waste, so I went for it, chemical engineering."

Despite her passion for dance, her decision to pursue engineering as a choice she couldn't be happier with.

"I don't, for one second, regret my decision to give it the focus but I do see dance fitting into my life in a bigger way down the road," she said. "Maybe one day, when I'm satisfied with what I've done with engineering, I just might start my own dance company."

Eric Bustamante

Senior, mechanical engineering

His foot taps the stage to the beat as his fingers begin to glide over the saxophone keys. In an instant, the rich definition and dark tone of his tenor sax steal all attention as his solo carries across the smoky dive.

The show with a local rock band is just another Friday night for Eric Bustamante.

Off stage, the 21-year-old is concentrated on finishing out his last semester before graduating with his bachelor's degree in mechanical engineering. It's a feat he actually pushed back to allow him the opportunity to find a better balance between engineering and his love of music.

For Bustamante, this hobby doesn't just tie him to weekend gigs at local clubs. He juggles a job tutoring school children on the saxophone with the rehearsals and travel that come along with being in UH's Moores School of Music Jazz Orchestra.

By invitation only, Bustamante was named to the first chair tenor saxophone position for the jazz orchestra last semester. Membership in another group for less experienced jazz musicians in six semesters previous, earned him the coveted place in the orchestra.

"The jazz orchestra is a yearlong commitment with a lot of travel and it requires I put in at least twice as much practice time as before," said Bustamante, who is the only member that is not pursing music as his major. "It takes a little more balancing, but it is definitely worth it."

Inspired by Lisa Simpson, a cartoon character who plays the saxophone on the longtime show, "The Simpsons," Bustamante began playing the instrument in middle school. He performed with the marching and jazz bands, among others, as he progressed through high school. But by the time he reached UH, he wasn't ready to quit.

"Ideally, I'll be playing this thing until I die," Bustamante said. "The feeling of playing an instrument and being able to communicate with others through it. Really, the chance to express your emotions with sounds—oh man, there is nothing like it."

He is continually massaging his musical talents, drawing influence from the works of Jazz greats such as Charlie Parker, Dexter Gordon, John Coltrane, Joe Henderson and Stan Getz. This is all while earning a regular place on the dean's list and managing membership in Alpha Lambda Delta, the National Society of Collegiate Scholars and the UH student chapters of Engineers Without Borders and the Society for Hispanic Professional Engineers.

Despite his demanding schedule, Bustamante said he couldn't picture his life without music or engineering in it. He is hopeful, upon earning his degree, he will be able to incorporate both into his career—one day following a longtime dream to design concert halls and work to troubleshoot unwanted sound and vibrations in spaces as an acoustic engineer.

Unraveling History

BY JOHN LIENHARD

A peculiar mischief came home to me on a business trip some years ago. I left my meeting to visit a highly-touted science museum. And, what I saw there, set off warning bells. It was a thoroughly modern hands-on exploratorium for school children. Here and there, mimes did little theater pieces. It offered children the same experiments I did as a college freshman: turn a knob and measure gravity—or the period of a pendulum. Place a ball in a stream of air and learn Bernoulli's principle—all so sensible, so user-friendly.

So I watched the children. They ran about, randomly throwing balls and pulling levers. They didn't see cause and effect; they only saw motion. Meanwhile, their unrewarded excitement drove them to a fever pitch of chaos. I watched and remembered my own visits to the museum. Mine were quiet and mysterious. I didn't understand everything there, either. But I knew it held secrets I must one day learn. I knew the force ran in that eerie place, filled with skulls, sarcophaguses and minerals.

Libraries face something similar. Their catalogs are now on our computers. We sit at our desk and call up the facts we once dug out of library stacks. We read our journals online.

So, what will become of the inner space that libraries once gave us? Long ago, in the Army, I'd flee my post and go to nearby William and Mary College. I sat under oak paneling browsing books on anything that caught my fancy. Like the old museums, that physical space held magic, and I drank it in.

Yet, with all today's compact shelving, robot assistance, and video image storage, remember: We still go to concerts despite our high-tech home audio systems. New technologies don't replace the best old technologies, they supplement them.

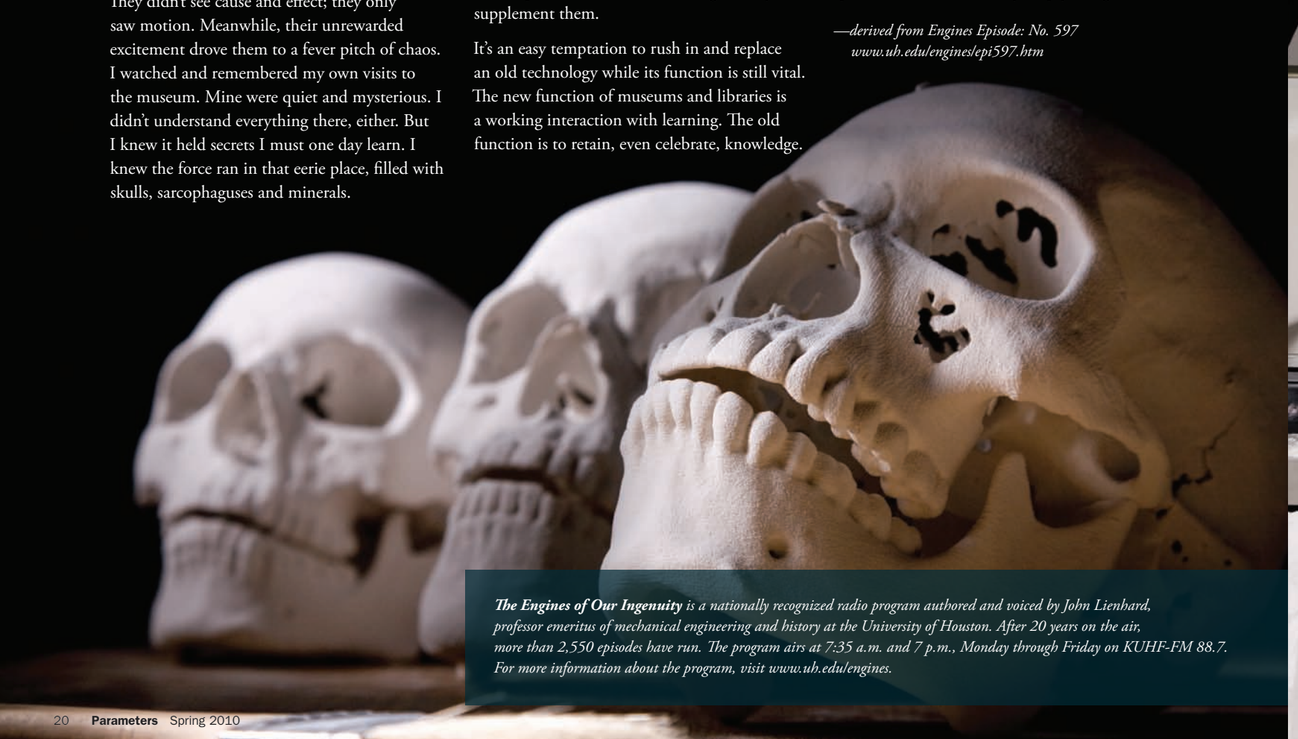
It's an easy temptation to rush in and replace an old technology while its function is still vital. The new function of museums and libraries is a working interaction with learning. The old function is to retain, even celebrate, knowledge.

Those buildings once told me the mysterious power of knowledge. We tiptoed and whispered as much to honor that presence as to avoid disturbance. Children and adults alike knew that instinctively.

Too many people look upon museums as housing ghosts of the dead, rather than the still-vital elements of a former life. They see museums as houses of dust. But these ghosts have immense vitality, and they serve us today. It all depends upon us the viewer, doesn't it? Approach a book or a museum or a school passively and the result can only be deadening.

Of course we want to do all we can to make knowledge accessible. But the ancient lore of our people is precious. Forget that, and the learning process will become a very empty thing.

—derived from Engines Episode: No. 597
www.uh.edu/engines/epi597.htm



The Engines of Our Ingenuity *is a nationally recognized radio program authored and voiced by John Lienhard, professor emeritus of mechanical engineering and history at the University of Houston. After 20 years on the air, more than 2,550 episodes have run. The program airs at 7:35 a.m. and 7 p.m., Monday through Friday on KUHF-FM 88.7. For more information about the program, visit www.uh.edu/engines.*

In the University of Houston Design and Free Form Fabrication Laboratory, Ali Kamrani has done his part to preserve a piece of American history.

An associate professor of industrial engineering, Kamrani voluntarily offered his time to aid a group of anthropologists, pathologists, museum curators and a forensic sculptor in the reconstruction of the skulls of three buffalo soldiers.

Together, these individuals from the Smithsonian Institution, the U.S. Bureau of Reclamation and the Buffalo Soldiers National Museum gave these Civil War era soldiers from New Mexico's Fort Craig, a face. Thought to be the first facial reconstruction to ever take place on a buffalo soldier, their work was featured in a museum exhibit in Houston throughout the month of February.

The replicas of the soldiers' skulls, which Kamrani created using his rapid prototyping machine, as well as much of the rest of the exhibit about life for soldiers at Fort Craig, is expected to be a permanent feature at the Houston-based Buffalo Soldiers National Museum later this year.

PHOTOS BY THOMAS SHEA

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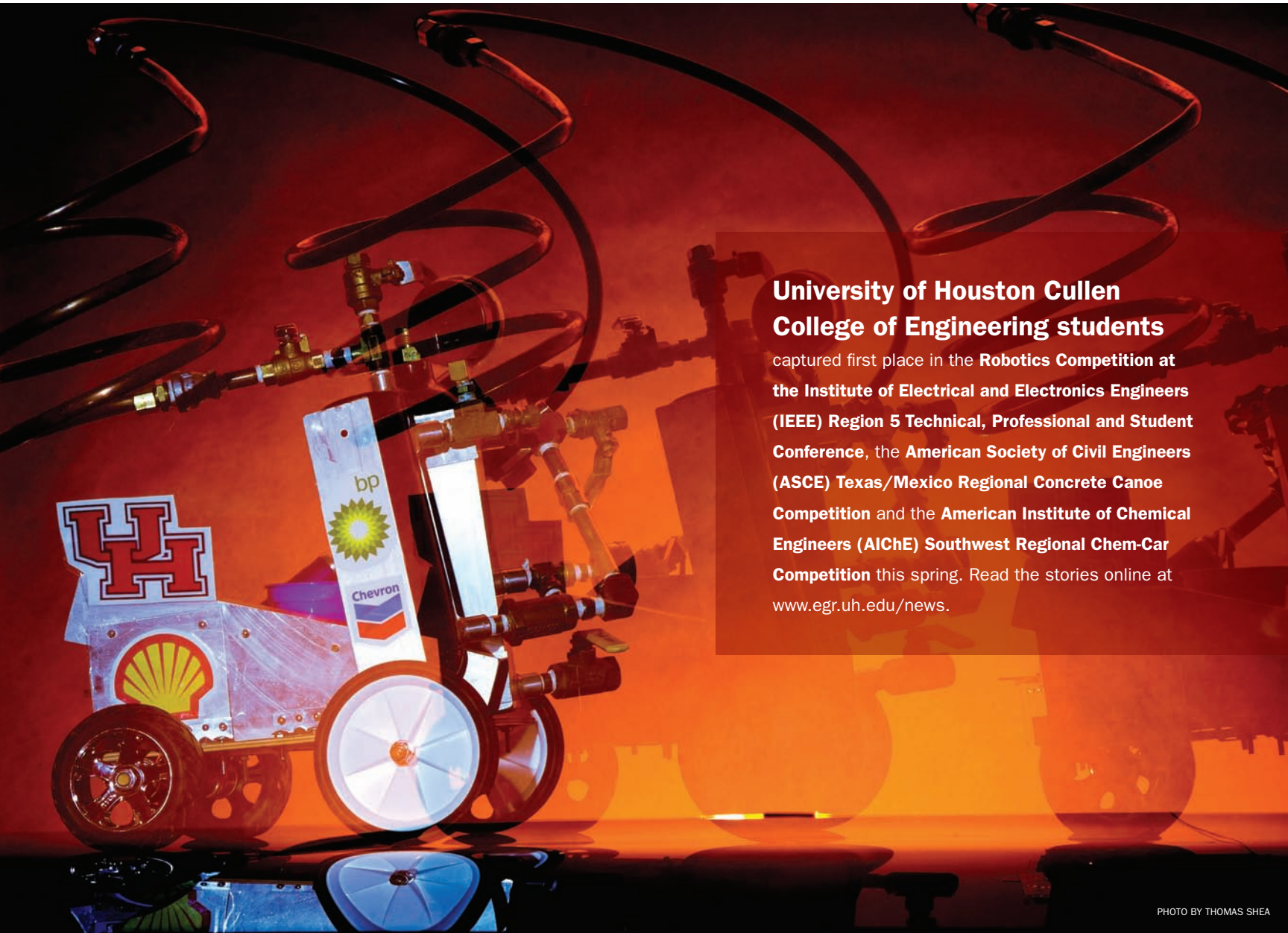

University of Houston Cullen College of Engineering students

captured first place in the **Robotics Competition at the Institute of Electrical and Electronics Engineers (IEEE) Region 5 Technical, Professional and Student Conference**, the **American Society of Civil Engineers (ASCE) Texas/Mexico Regional Concrete Canoe Competition** and the **American Institute of Chemical Engineers (AIChE) Southwest Regional Chem-Car Competition** this spring. Read the stories online at www.egr.uh.edu/news.

PHOTO BY THOMAS SHEA